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AN APPROACH FOR ESTABLISHING BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE (BATEA) UNDER PUBLIC LAW 92-500 WITH APPLICATIONS TO THE ORGANICS, SYNTHETICS AND PLASTICS INDUSTRY

ENVIRONMENTAL PROTECTION AGENCY

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The ~~ES&WQIAC~~ undertook an extensive study effort throughout the Summer of 1975 to develop a new approach for establishing Best Available Technology Economically Achievable (BATEA) under PL 92-500. This report presents an overview of the approach developed. The approach effectively establishes the technical and economic information needed as well as providing a systematic method for utilizing the data to assist in establishment of effluent limitations. Of special interest should be the assistance provided the policy marker by the approach. The approach makes explicit the incremental improvement in effluent quality achieved vs. the cost of achievement thus providing the needed information to make the trade-off decision.

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WASHINGTON, D.C.

December 1975

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

EFFLUENT STANDARDS AND WATER QUALITY
INFORMATION ADVISORY COMMITTEE
Dec. 19, 1975

The Honorable Russell E. Train
Administrator
U.S. Environmental Protection Agency
Waterside Mall West
Washington, D. C. 20460

Dear Mr. Train:

The establishment of industrial effluent limitations for 1977 utilizing Best Practical Control Technology Currently Available (BPCTCA) and for 1983 utilizing Best Available Technology Economically Achievable (BATEA) both have posed difficult problems. The former largely due to extremely tight deadlines and the latter due to the need for long range forecasting of technological and economic implications.

The Effluent Standards and Water Quality Information Advisory Committee (ES&WQIAC) has attempted to meet its responsibilities for BPCTCA through on-going industrial workshops and critiques of documents. In the case of BATEA the Committee undertook an extensive study effort throughout the Summer of 1975 to develop a new approach for establishing BATEA.

This report presents an overview of the approach developed. The approach effectively establishes the technical and economic information needed as well as providing a systematic method for utilizing the data to assist in establishment of effluent limitations. Of special interest to you should be the assistance provided the policy maker by the approach. The approach makes explicit the incremental improvement in effluent quality achieved vs. the cost of achievement thus providing the needed information to make the trade-off decision.

Respectfully,

Martha Sager

Martha Sager
Chairman, ES&WQIAC

iv

F O R E W O R D

The establishment of effluent standards for Best Available Technology Economically Achievable (BATEA) for industry under Public Law 92-500 poses an extremely difficult problem for the Environmental Protection Agency.

Under the law, standards must be established for achievement of Best Practical Technology in 1977 and BATEA for 1983. Projecting to 1983 involves suppositions on timely achievement of 1977 standards as well as difficult long range technical and economic judgements.

In view of the difficult problem posed by PL 92-500 in establishing BATEA, the Effluent Standards and Water Quality Information Advisory Committee (ES&WQIAC) established a special task to develop an approach to meet the problem and assist the EPA.

The approach developed involves a method to define and structure the data and information required so that both environmental and economic factors are effectively weighed in the decision process. The method also makes explicit - for the policy maker - the relative costs and benefits which may be incurred by his decisions.

The approach does not consider, at this stage, all variables which would be introduced in a full implementation by the Agency. However, it does provide a basis for alerting industry on the types of data and information required and a systematic manner to analyze and utilize this data and information in making the technical, economic and policy decisions needed to establish the BATEA effluent standards.

AN APPROACH FOR ESTABLISHING BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE (BATEA) UNDER PUBLIC LAW 92-500 WITH APPLICATIONS TO THE ORGANICS, SYNTHETICS AND PLASTICS INDUSTRY

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TABLE OF CONTENTS

FOREWORD

INTRODUCTION 1

THE PROPOSED BATEA METHOD 2

ILLUSTRATIVE EXAMPLE OF THE ALTERNATIVE BATEA APPROACH 8

RESULTS OF THE ILLUSTRATIVE EXAMPLE 9

DATA AND TIME NEEDED TO IMPLEMENT ALTERNATIVE BATEA APPROACH 15

CLOSURE 17

APPENDIX 18

BATEA TASK FORCE SCHEDULE 19
ES&WQIAC MEMBERSHIP 20

AN APPROACH FOR ESTABLISHING BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE (BATEA) UNDER PUBLIC LAW 92-500 WITH APPLICATIONS TO THE ORGANICS, SYNTHETICS AND PLASTICS INDUSTRY

Introduction

This report describes a new approach for developing effluent limitation guidelines for the "Best Available Technology Economically Achievable" (BATEA) to be attained by July 1, 1983 as specified in PL 92-500. The report includes an illustrative example from the organic chemicals industry of how the approach can be employed.

The need for a new approach to developing BATEA guidelines was made evident through the ES&WQIAC's analysis of proposed BATEA standards as well as the numerous court suits pending on the currently published, and/or proposed standards. Controversies have centered on questions of whether or not the current guidelines are attainable through the application of BATEA and, perhaps more significantly, whether the guidelines are "ecomomically achievable". The proposed approach provides a systematic method to effectively assist in developing BATEA considering assured technology and cost implications. Furthermore the approach facilitates the making of policy decisionss involving trade-offs between effluent quality and economic impact.

The Proposed BATEA Method

The proposed BATEA development methodology involves comparing the waste load reductions obtainable by and the costs incurred through two BATEA options. One option is the addition of an advanced technology wastewater treatment system to the "Best Practical Control Technology Currently Available" (BPCTCA) facility. The other option is reducing the raw waste load (RWL) to the BPCTCA facility by various in-plant modifications and improving the quality of effluent by further conventional treatment as is practicable. If the overall waste discharge reduction obtained by the in-plant modifications is "reasonably" close to that obtainable by the advanced technology treatment option; and if the costs of the in-plant option are "significantly" less than that of the other, then the BATEA standards might be based on the in-plant modifications with BPT treatment. What is "reasonably" close waste reduction and what is "significantly" less cost are primarily policy decisions weighing economic and environmental impact. Thus, while focusing on advanced treatment technology, this approach puts a clear emphasis on the economic and environmental trade-offs in pollution control technologies.

Figure 1 presents the outline of this alternative BATEA approach. The following paragraphs discuss specific aspects of each step.

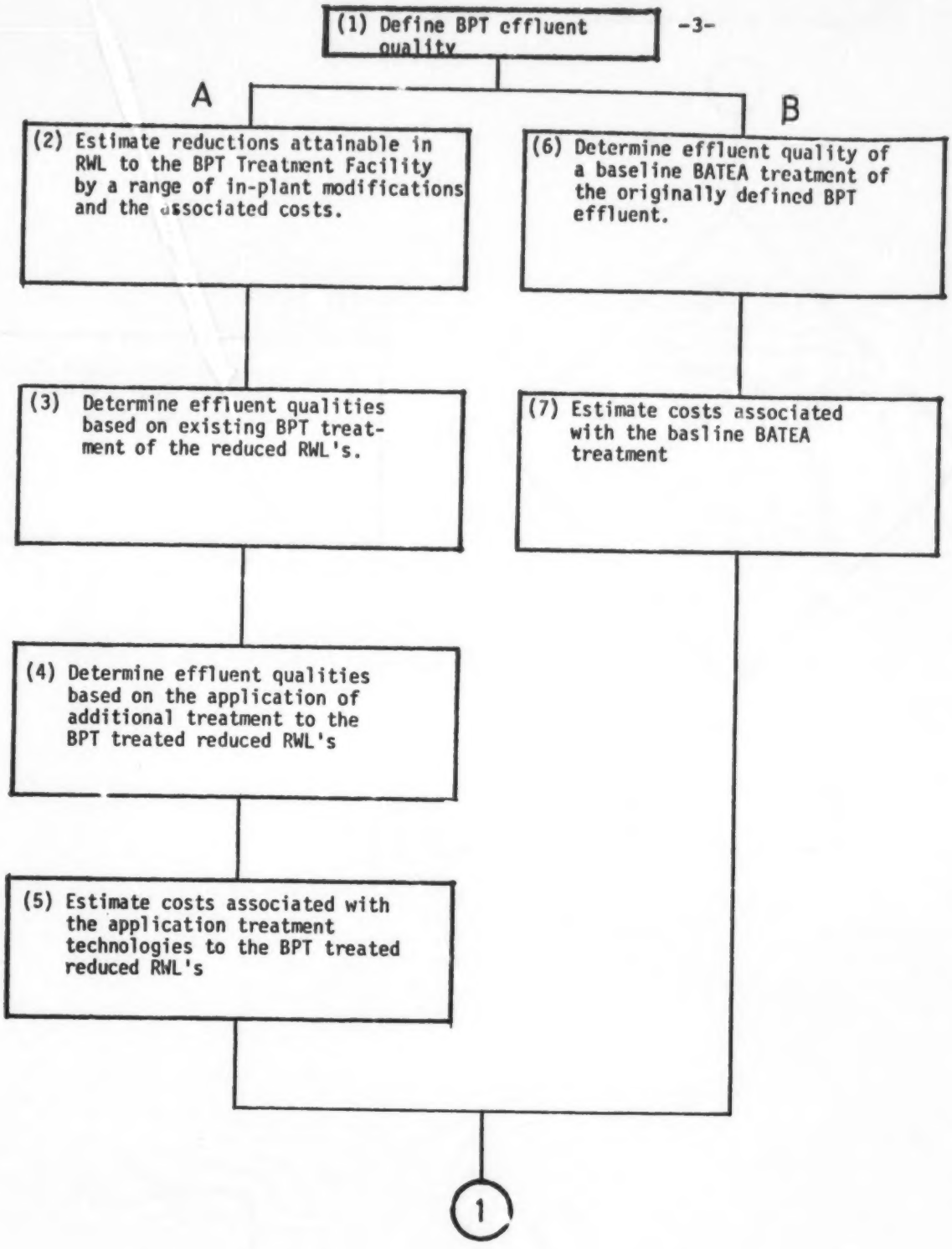
(1) Define BPT effluent quality
A
B
(2) Estimate reductions attainable in RWL to the BPT Treatment Facility by a range of in-plant modifications and the associated costs.
(6) Determine effluent quality of a baseline BATEA treatment of the originally defined BPT effluent.
(3) Determine effluent qualities based on existing BPT treatment of the reduced RWL's.
(7) Estimate costs associated with the basline BATEA treatment
(4) Determine effluent qualities based on the application of additional treatment to the BPT treated reduced RWL's
(5) Estimate costs associated with the application treatment technologies to the BPT treated reduced RWL's
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Figure 1: Outline of Alternative BATEA Approach
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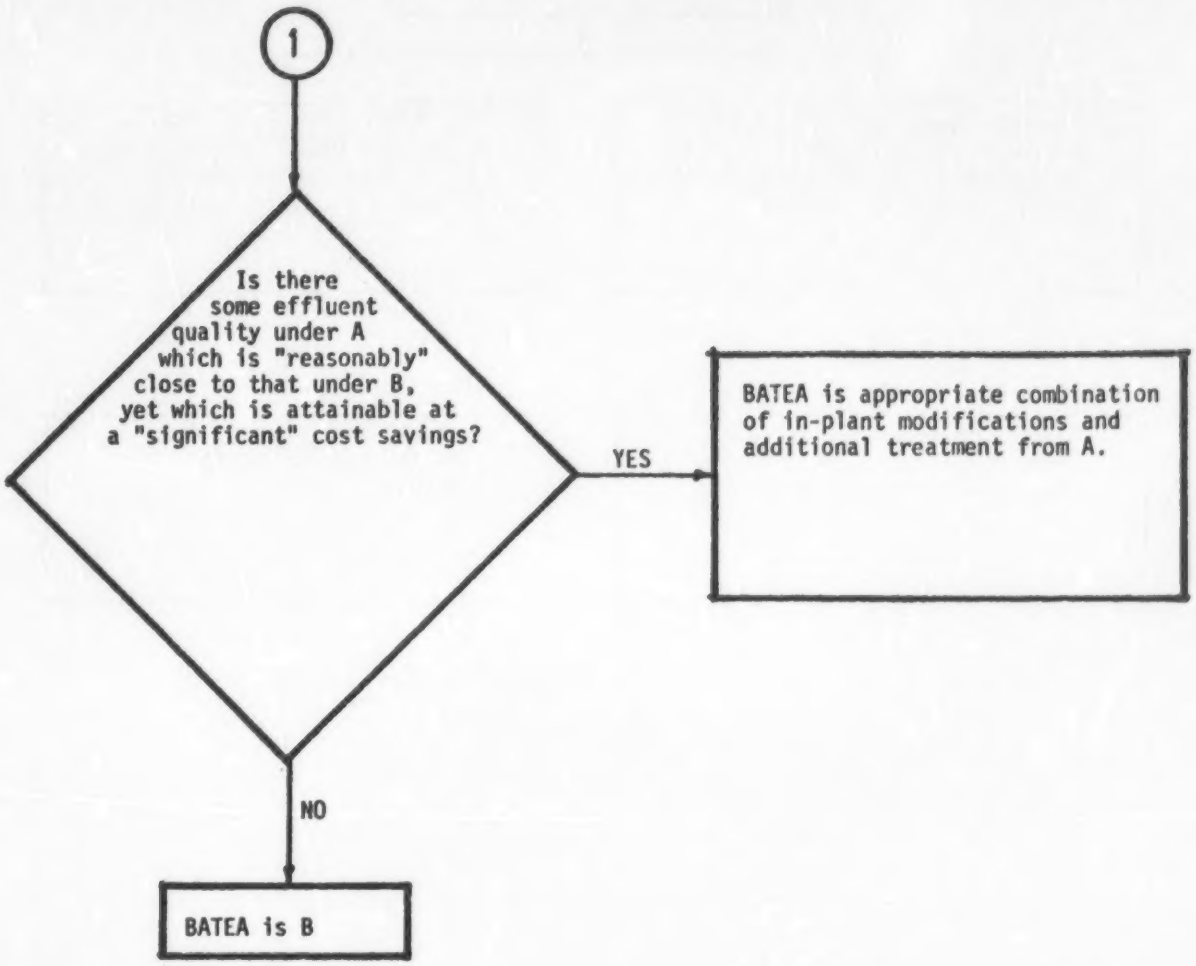
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Is there some effluent quality under A which is "reasonably" close to that under B, yet which is attainable at a "significant" cost savings?
YES
BATEA is appropriate combination of in-plant modifications and additional treatment from A.
NO
BATEA is B

Figure 1: (Continued)

1) Define BPT effluent quality - This effluent quality will be that which is actually produced at a plant site by application of BPT treatment and will not necessarily correspond to presently published or proposed EPA guidelines. The effluent quality will be that which is achievable from a properly operated BPT treatment facility. (It is assumed that when BATEA is considered BPT will already be in operation or the results highly predictable.)

2) Estimate reductions attainable in RWL to the BPT treatment facility by a range of in-plant modifications and the associated costs - This estimate will be accomplished by each plant in the industry for its own particular product and process situation. There will be a range of process and facility modifications which are possible and which will have varying effects on the RWL. The effects on RWL may range from relatively minor change with similarly low cost to substanial change involving extensive plant modifications and very significant costs.

3) Determine effluent qualities based on existing BPT treatment of the reduced RWL's - Without modifying the existing treatment facilities, reduction in the final effluent level may be predicted for each reduction in RWL. In determining this reduction,

some of the operating parameters, such as reaction rate and feed rate, may need to be adjusted. For example, if the RWL reductions result in the chemical constituents of the influent to treatment being markedly changed, a laboratory study may be needed to revise the rate constant. (The rate constant being an indication of treatability.)

4) Determine effluent qualities based on the application of additional treatment to the BPT treated reduced RWL's - The quality of the final effluent from the existing BPT treatment system may be further improved by additional treatment technologies, such as coagulation-flocculation, dual-media filtration, polishing ponds, addition of coagulant to the final clarifier, addition of powdered carbon to the aeration basin, etc. Using existing models and knowledge of the operating parameters, effluent levels for each of the additional treatment schemes can be predicted. In many cases associated laborabory and pilot plant studies would be required.

5) Estimate costs associated with the application of additional treatment technologies to the BPT treated - reducted RWL's.

6) Determine effluent quality of a baseline BATEA treatment of the originally defined BPT effluent - For the purpose of establishing this baseline effluent quality, an appropriate advanced technology BATEA treatment must be set. In setting this baseline BATEA, operating parameters should also be provided as guides. The effluent level attainable by the proper design and operation of this treatment can be established either by existing models, where the parameters are available, or by pilot plant studies, taking into account the effects of scale-up.

7) Estimate costs associated with the baseline BATEA treatment.

At this point, the cost and effluent quality data obtained by the preceding steps will permit a reasoned judgment of which pollution reduction option is the best economically achievable. If the decision rule developed from the established policy* is satisfied by the in-plant modifications regarding "reasonably" close effluent quality and "significantly" less cost, then the effluent reduction obtainable by the in-plant modifications becomes the BATEA guideline. Otherwise, the advanced technology wastewater treatment system defines the BATEA guidelines.

*The established policy will include economic and environmental impact implications.

Illustrative Example of the Alternative BATEA Approach

An illustrative example of the application of this alternative approach to BATEA guidelines was developed through the cooperation of Union Carbide Company (UCC). The projected data on the effect of in-plant modifications and advanced technology wastewater treatment on RWL was provided by by UCC from analysis of a specific plant. UCC was in a position to provide this data only because it had already begun investigations into the costs and effects of in-plant modifications to reduce the RWL to its wastewater treatment plant. The UCC production facility considered in this example is an older plant, which produces a wide variety of organic chemicals.

In the example, the BPT treatment system is defined as a well-designed and properly operated activated sludge treatment plant. The total effluent BOD_5 from the BPT system is determined by a model developed at UCC that has been demonstrated to be applicable to their operations.

The baseline BATEA treatment system is defined for this example as end-of-pipe addition of dual-media filtration and three activated carbon columns in series. These unit processes are preceded by coagulation-flocculation of the activated sludge effluent to reduce suspended solids and improve the efficiency of the subsequent filtration unit. The waste removal efficiencies of these processes are based on pilot and laboratory tests performed by UCC.

In developing the data regarding the in-plant modifications, UCC assigned a study team consisting of representatives from the wastewater treatment plant, divisional research and development, the production units, and engineering staff. At the time of this ES&WQIAC study, the UCC team had been working about three months. Within this time frame, the information developed can only be considered tentative. For purposes of this example, some cost and treatment assumptions had to be made. The assumptions, however, are considered reasonable and sufficiently accurate to demonstrate the applicability of the suggested BATEA approach. In the actual implementation of the approach, the assumptions would be replaced by data developed from valid engineering and cost analysis.

Results of the Illustrative Example

The initial conditions at BPT operation are a flow of 11.1 Million Gallons/Day (MGD), and a soluble BOD_5 RWL of 55,700 pounds per day (lbs/day). The BPT treatment facility reduced the total BOD to 6300 lbs/day in the effluent. The effluent TSS from BPT is 8510 lbs/day and other effluent parameters are as presented in Table 1.

The addition of coagulation-flocculation (C-F) to the BPT facility, which is considered a necessary process for both the baseline BATEA and the in-plant modifications, reduces the effluent TSS to 4620 lbs/day and total BOD_5 to 5000 lbs/day.

TABLE 1: Summary of Data From Illustrative Example

Graph Code	Pollution Reduction Scheme	Influent to Treatment		Effluent from Treatment				Annual Costs*		
		Flow (MGD)	Sol. BOD_5 (1000lb/day)	Sol. BOD_5	Tot. BOD_5 (1000 lb/day)	COD	TSS	Capital	Operating ($MM)	Total
BPT	BPT	11.1	55.7	3.50	6.30	41.78	8.51	----	----	----
A	BPT & C-F	11.1	55.7	3.50	5.00	36.33	4.62	0.21	0.22	0.43
F	All In-plant changes & BPT & C-F	8.3	37.1	2.35	3.50	25.43	3.46	0.71	0.22	0.93
G	All In-plant changes & BPT & C-F & filtration	8.3	37.1	2.35	2.81	22.52	1.38	0.93	0.40	1.33
H	BPT & C-F & Baseline BATEA	11.1	55.7	2.27	2.57	17.85	0.92	1.20	2.90	4.10

* Costs presented are those above the cost of the installed BPT facility. All costs are 1975 dollars.

The costs above BPT of this treatment addition are $0.21 million (MM) annual capital cost (calculated as 10% of the total initial investment in all cases) and $0.22 MM annual operating cost. Thus the total annual cost of this addition is $0.43 MM above the installed BPT system.

The effect of the implementation of all of the in-plant modifications identified by UCC is to reduce the influent to the BPT facility to a flow of 8.3 MGD and a soluble BOD_5 RWL of 37,000 lbs/day. The BPT facility plus the coagulation-flocculation process reduces the effluent total BOD_5 to 3500 lbs/day and TSS to 3460 lbs/day. The associated annual capital cost above BPT is $0.71 MM (including the previously identified C-F process), and the annual operating cost remains $0.22 MM. The total annual cost of this option is then $0.93 MM above the installed BPT cost.

By adding a dual-media filtration unit to the BPT plus C-F treatment facility, the effluent after the in-plant changes is reduced to TSS of 1380 lbs/day and total BOD_5 to 2810 lbs/day. With this addition, the annual capital cost increases to $0.93 MM and the annual operating cost to $0.40 MM, for a total annual cost of $1.33 MM above the installed BPT cost.

As noted previously, the baseline BATEA treatment for this example is defined as dual-media filtration followed by three activated carbon columns in series. The addition of

this baseline BATEA to the BPT plus C-F treatment facility reduces the original RWL's without in-plant modifications to effluent values of 2570 lbs/day for total BOD_5 and of 920 lbs/day for TSS. The annual capital cost for this option is $1.2 MM (including the C-F process), and the annual operating cost is $2.9 MM (also including the C-F process). The total annual cost above the installed BPT facility is then $4.1 MM.

The above information is reflected in Table 1, along with effluent soluble BOD_5 and effluent COD data. The relationships between reductions in effluent levels of total BOD_5, COD, and TSS from their BPT levels and the total annual costs of the above pollution reduction schemes is presented graphically in Figure 2.

The total annual cost and effluent load reduction values of Figure 2 may be indexed so that the baseline BATEA values are considered 100 percent and the BPT values are considered zero percent. This indexing system is presented in Table 2. From the table, it is readily seen that the total annual cost of making all of the in-plant modifications and adding coagulation-flocculation and filtration to the BPT facility is about 33 percent of the cost for the baseline BATEA. Yet the in-plant option achieves about 94 percent of the total BOD_5, 81 percent of the COD, and 94 percent of the TSS reductions obtainable with the baseline BATEA option.

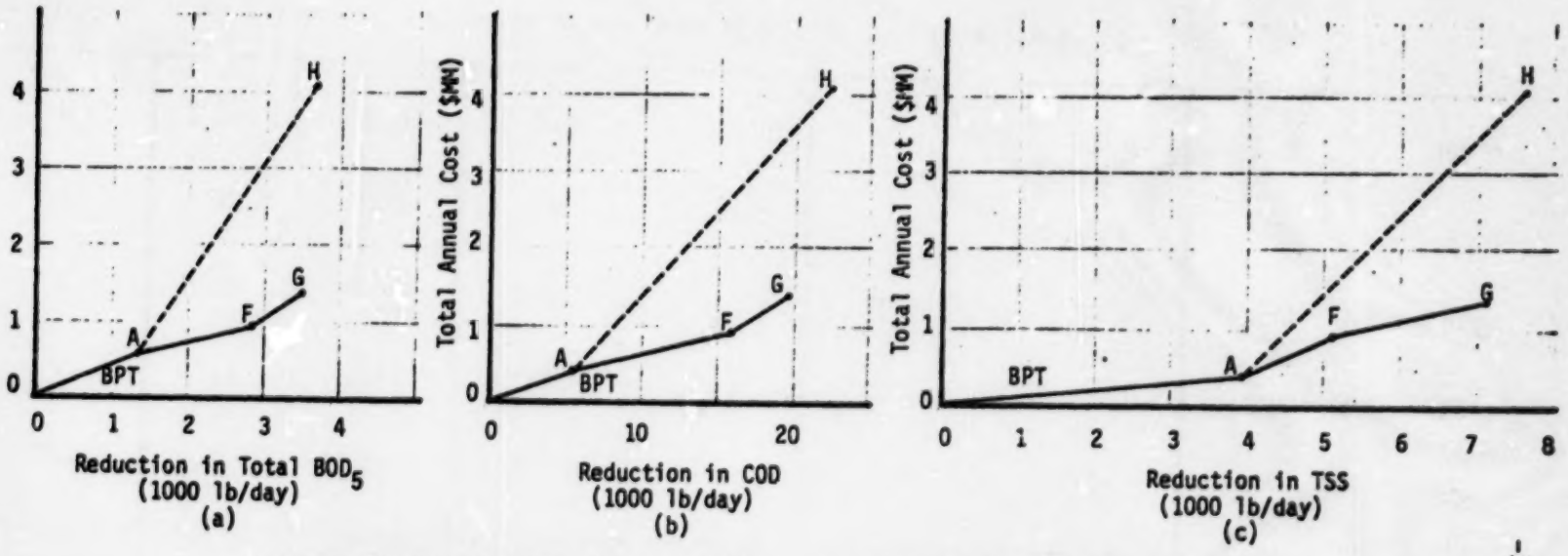


Figure 2: Relationships between Total Annual Costs of Treatment Schemes above BPT Costs and Reduction in Effluent Loads from BPT Loads.*

* Coding of data points is indicated in Table 1

TABLE 2

Total Annual Costs and Effluent Reductions Indexed* to Baseline BATEA

Pollution Abatement Scheme	Total Annual Cost above BPT		Reduction of Effluent Load from BPT					
			BOD_5 (tot)		COD		TSS	
	$MM	Indexed	1000 lbs/day	Indexed	1000 lbs/day	Indexed	1000 lbs/day	Indexed
BPT	---	-0-	---	-0-	---	-0-	---	-0-
A	0.43	10.5	1.30	34.9	5.45	22.8	3.89	51.3
F	0.93	22.7	2.80	75.1	16.35	68.3	5.05	66.5
G	1.33	32.4	3.49	93.6	19.26	80.5	7.13	93.9
H	4.10	100.0	3.73	100.0	23.93	100.0	7.59	100.0

* Baseline BATEA = 100; BPT = 0; other values then represent % of baseline BATEA

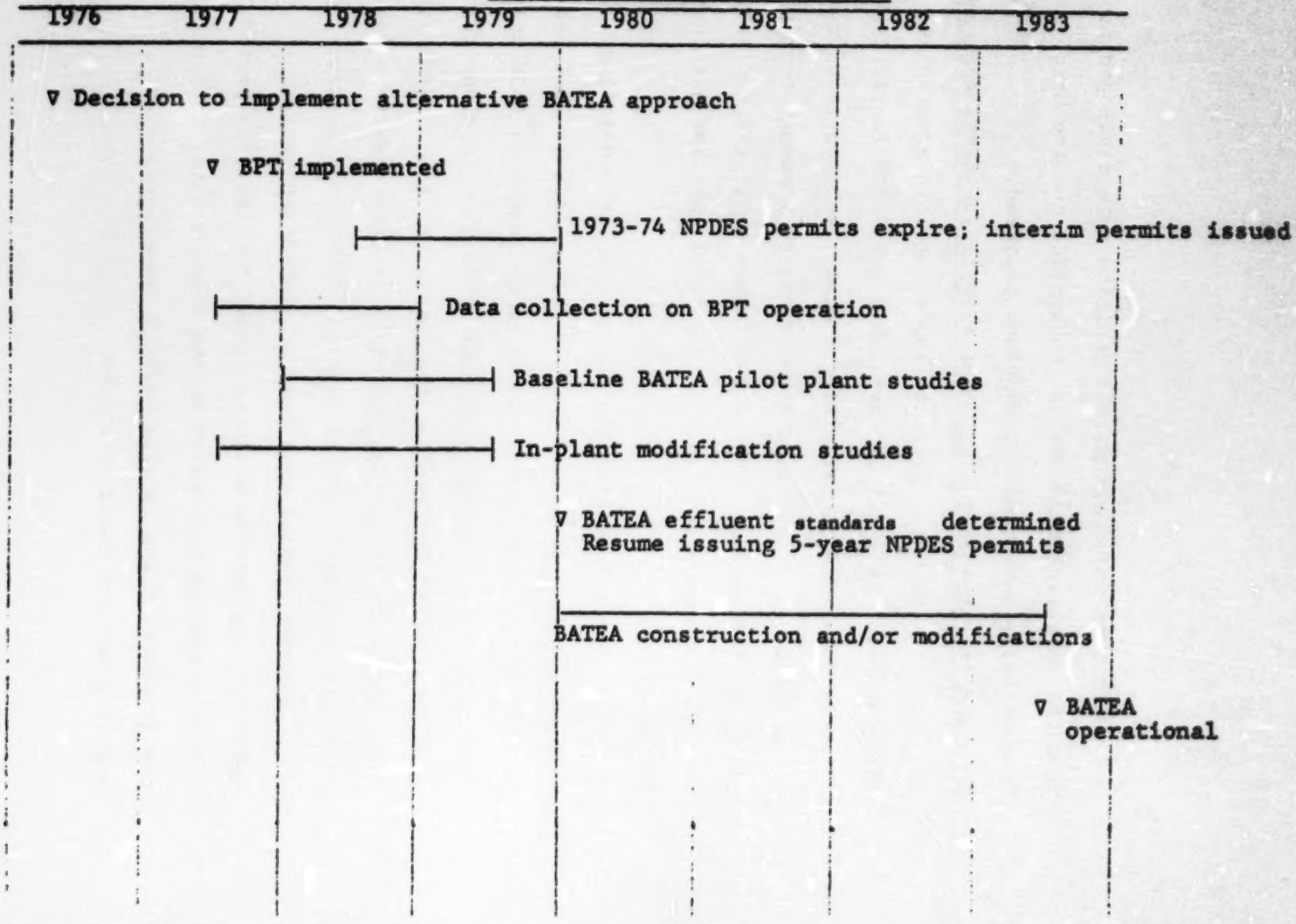
With this information, the decision rule developed from from the established policy can be applied and the best, "economically achievable" technology selected.

Data and Time Needed to Implement Alternative BATEA Approach

Much of the data needed to implement this alternative BATEA approach will not be available until BPT facilities are in operation. The actual effluent qualities from these systems is an example. In addition it will not be possible to run pilot plant studies on the BPT effluents until the facility is installed. However, it is possible to collect RWL data prior to BPT operation.

Figure 3 illustrates the timing for implementation. Permits began to be issued in 1973 for periods of five years. Therefore, new permits will begin to be issued in 1978 which will carry into the effective date of BATEA. In order that such permits may be based on the results of the alternative BATEA approach, it is suggested that interim permits be issued until the completion of the baseline BATEA and in-plant modifications studies have been completed and analysed. These interim permits would be issued for the time period encompassing the completion of the above tasks. To simplify the issuance of the interim permits, extensions of the expiring permits could be issued.

Figure 3: Tentative Time Schedule for Implementation of Alternative BATEA Approach



Closure

The alternative approach was developed in general terms. Topics not addressed in the approach as presented in this report include:

* subcategorization of point source categories
* variability factors
* plants which will have already exceeded 1977 effluent limitations through installation of in-plant modifications.

Despite these simplifications the illustrative example demonstrates a systematic method for effectively assisting in establishing BATEA. The sample case established the fact that modifications to plant production processes could result in effluent discharges nearly as low as those which are obtained from advanced technology wastewater treatment facilities.

More importantly, the model demonstrated, that the cost of in-plant modifications were only about 35 percent of the costs of an advanced wastewater treatment facility, thus making in-plant process changes an economicaly feasible way to meet effluent standards.

A P P E N D I X

BAT TASK FORCE SCHEDULE
(Revised July 22, 1975)

(Organics, et al, and Paperboard)

ES&WQIAC MEETING DATE	LOCATION	MILESTONE	MEETING ACTION
July 18 & 19 (Fri./Sat.)	Univ of Kentucky Lexington, Ky.	Completion of Data Collection	Review Data; Decide on Methods of Analysis
Aug. 18 & 19 (Mon./Tue.)	Vanderbilt Univ. Nashville, Tenn.	Completion of Initial Analysis	Develop Report Outline
Sept. 25 & 26 (Thurs./Fri.)	ES&WQIAC Wash., D.C.	Completion of Draft Report	Review Draft Report, Revise, Produce Final Version
Oct. 30 (Thurs.)	ES&WQIAC Wash., D.C.	Final Action on Report	Agreement on Disposition of Final Report

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